Follow-up work will augment the numerical simulations with particle and/or granular gas models to examine the effect of these vorticity-induced waves on particle migration, accumulation, and (possibly) planetesimal formation.

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Liquid Water on Present-Day Mars?

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Near-surface environmental conditions on Mars today are generally considered inadequate to permit liquid water to exist in equilibrium with the atmosphere. Mean annual temperatures are about 50–60 kelvin (K) below the melting point, and mean annual surface pressures are very close to the triple point. Yet there are localized regions where, for a few hours of the day at the right time of year, surface temperatures and pressures meet the minimum requirements for the existence of liquid water: pressures and temperatures above the triple point of water but below the boiling point.

That such conditions do exist was determined using a validated General Circulation Model. The model predicts where and for how long liquid water could exist each Martian year. For pure liquid water, the model predicts that liquid water might occur in five regions: between 0 and 30 degrees North in the plains of Amazonis, Arabia, and Elysium; and in the Southern Hemisphere impact basins of Hellas and Argyre. The combined area of these regions represents 29% of the surface area of the planet. In the Amazonis region, these requirements are satisfied for a total integrated time of 37 sols each Martian year. In the Hellas basin, the number of degree-days above 0 is 70, a number that is well above those experienced in the dry valley lake region of Antarctica.

Whether liquid water ever forms in these regions depends on the availability of ice and heat, and on the evaporation rate. The latter is poorly understood for low-pressure CO_2 environments, but is likely to be so high that melting occurs rarely, if at all. However, even rare events of liquid-water formation would be significant because they would dominate the chemistry of the soil, and would have biological implications as well.

Interestingly, these regions are remarkably well correlated with the location of impact craters that appear to have been filled with lakes at some time in the past. Approximately 86% of the more than 100 impact crater lakes lie within the model-predicted regions where conditions for liquid water are favorable. The lakes do not exist today, but appear to have existed within the last several billion years, and some appear to have existed within the last several hundred million years. The reason for this amazing correlation is not known.

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